The American Midland Naturalist

PUBLISHED BI-MONTHLY BY THE UNIVERSITY
OF NOTRE DAME, NOTRE DAME, INDIANA

VOL. VIII. MARCH, 1922. NO. 2.

Seasonal Dimorphism in Arisaema Triphyllum.

THEO. HOLM.

(With 5 figures drawn by the author.)

Along the Maryland Pike from Silver Hill to Clinton, Prince George County) are several tracts of woodland, mostly with *Liriodendron, Liquidambar, Nyssa, Acer rubrum* and various oaks. There are many creeks and frequently, during the winter months, large areas of the woods become inundated. There is a luxuriance of ferns, notably *Woodwardia areolata, Asplenium Filix-femina, Polystichum, Onoclea sensibilis, Dicksonia, Osmunda,* and even the rare *Ophioglossum vulgatum* is quite abundant.

But when the Spring commences there is no trace of *Podophyllum, Sanguinaria, Claytonia, Anemonella, Dentaria, Erythronium or Osmorhiza;* the vernal Grasses are scarce. But there are many *Carices,* and *Symplocarpus* is at its very best, not to speak of *Viola cucullata, Oakesia,* and *Rhus Toxicodendron,* while *Orontium* follows the creeks. Not until late does *Arisaema triphyllum* appear in these surroundings, and when it commences to bloom, the plant on the Potomac shore near Washington has passed flowering more than a month earlier.

When finding this plant near Clinton barely in bloom in the middle of May, its remarkable low stature attracted my attention, beside the late time of its appearance. *"Nana"* or *"Serotina"* would have seemed an appropriate name, but it so happened that the plant proved to be the variety *pusilla* already described by Peck,[1] and recently raised to specific rank: *A pusillum* (Peck) Nash in Britton's manual.

However, considered as a mere variety or at least as a form this plant seems more interesting than as a new species. It actually indicates how a species may be developed, and from

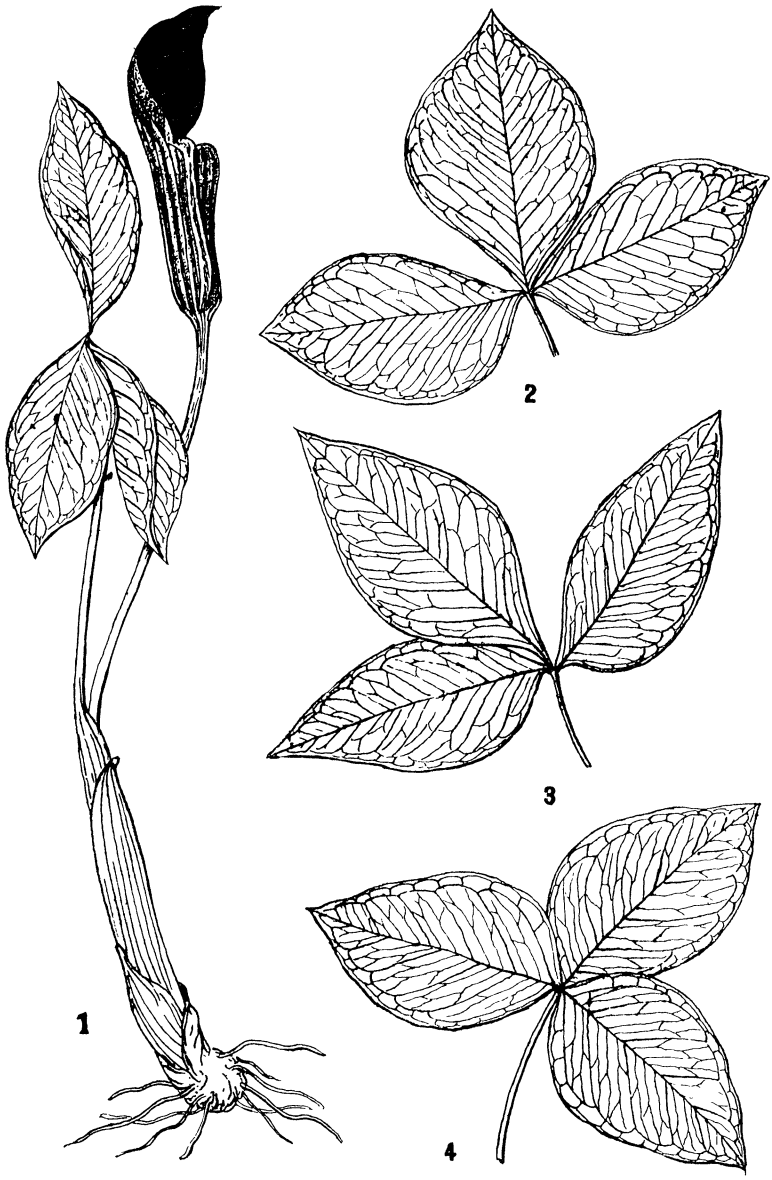
1 Report New York state Museum 51: 297. 1897.

this point of view the plant will be treated in the subsequent pages. Peck (l. c.) describes the plant as follows: "Plants 3 to 6 inches high; leaves usually solitary, the leaflets narrowed and pointed at the base, 12 to 18 lines long, 7 to 9 wide; the upper part of the spathe commonly dark purple. Millbrook, Dutchess county, June. The plants were in flower June 15th; about a month later than the time of flowering of the typical form of the species in the same locality." No additional characters are mentioned in Britton's manual, and the habitat is given as "open sunny bogs New York."

Having had the opportunity to study the plant throughout the summer, and in localities where it occurs in abundance, I have observed several points in its external structure, by which it may be readily distinguished from the typical form. So far as concerns the vicinity of Washington (Maryland and Virginia) typical *Arisaema triphyllum* appears to be mostly dioecious. It is a plant of rather robust habit, especially when compared with the var. *pusilla* (Fig. 1) at the corresponding state. The leaf-segments are elliptical-ovate, pointed, and they are very broad in young specimens (Fig 4), which have not yet reached the flowering state. The relative length and width of the middle segment correspond well with those of the two lateral. The color of the spathe varies from light green to dark purplish-brown or variegated with dark purple and whitish stripes or spots.

Now with regard to the var. *pusilla* (Fig. 1) the plant is very slender with the scape frequently bent; the spathe and spadix are smaller than in the type, and the color of the spathe is most often dark purplish-brown to almost black or, though more seldom, pale green with no dark spots or stripes. The staminate plant seems to be the most common, and I found no monoecious specimens. The staminate plants are generally of a lower stature than the pistillate, but the color of the spathe varies in both.

While the name "*pusilla*" is very appropriate to the plant, so far as concerns the small size of the leaves, spathe and spadix, when it appears above ground, the stem or floral scape, does not remain low, but grows rapidly, and may reach the height of 25 to 34 cm. in fruiting specimens, measured from the corm to the base of the spadix. The foliage may



EXPLANATION OF FIGURES.

Figure 1. *Arisaema triphyllum* (L.) Schott. var. *pusilla* Peck; two-thirds of the natural size.

Figures 2 and 3. Leaves of young specimens of same variety, in third year; two-thirds of the natural size.

Fig. 4. Leaf of a young specimen of typical *Arisaema triphyllum* in its third year; two-thirds of the natural size

Fig. 5. Leaf of a mature specimen of the variety *pusilla*; natural size.

also attain quite a considerable size. Concerning the shape of the leaf-segments, these are generally narrower than the type. This difference is evident even in young specimens (Figs. 2-3), which have not yet reached the flowering state. In mature leaves the relative size and outline of the segments are quite distinct from that of the typical plant. As a matter of fact it seems characteristic of the variety *"pusilla"* that the central leaf-segment is shorter and broader than the two lateral. Furthermore, the lateral segments often exhibit an outline approximately falcate. Among the numerous specimens which I examined, leaves in which the three segments were of uniform shape and size were rare. The leaf figured (Fig. 5)may give some idea of the general size and outline of the leaf of a mature specimen of the variety. The largest leaves are of course to be found in fruiting specimens. When two leaves are developed the basal is always larger than the superior. For instance in a fruiting specimen, collected on the second day of August the two leaves showed the size as follows:

Basal leaf: central segment, length 16.5 cm. width 9.0 cm.
Basal leaf: lateral segment, length 22.0 cm. width 7.0 cm.
Superior leaf: central segment, length 14.0 cm. width 5.5 cm.
Superior leaf: lateral segment, length 15.0 cm. width 5.4 cm.

In a staminate specimen, collected on May 31st, the single leaf measured:

Central segment length 9.5 cm. width 4.2 cm.
Lateral segment length 12.0 cm. width 3.1 cm.

As compared with the typical plant the variety *pusilla* is thus readily distinguished by (1) its late appearance, late blooming and fruiting; (2) the relatively smaller size of inflorescence, spathe and spadix; (3) the uniform deep color of the spathe, except in chlorotic specimens; (4) the leaf-segments being narrower, and the two lateral being generally longer and narrower than the central (Fig. 5) ; (5) the approximately falcate shape of the lateral segments; and finally (6) the habitat being either low woods, partially inundated during the winter, or sphagnum-bogs.

I have not, so far, found the typical plant and the variety growing together, and considering the nature of the surroundings, I presume these to be the direct environal cause

of the modified structure observable in the variety *pusilla*. In other words *Arisaema triphyllum* illustrates a case of seasonal dimorphism, which might eventually lead to the segregation of a second species, similar to the species of *Gentiana* and *Euphrasia*, described by Wettstein[2], and *Alectorolophus* by Sterneck.[3]

In his very instructive work, Grundzüge der geographisch-morphologischen Methode der Pflanzensystematik (Jena 1898), Wettstein points out the possibility of ascertaining the phylogenetic relations of species by a comparison of the morphological structure and the geographical distribution. As a point of issue this author maintains, that a species occupying an area, where the conditions suffer no change, may remain constant, except in case of eventual hybridization or individual variation. But, if the conditions become modified in some part of this area, or if the species spreads beyond the limits of the regions with other conditions, the species will naturally adapt itself to the new environments, and so result in the development of a new species. Such new species may be readily connected with the parental, when the areas are not too remote from each other. Some transitional forms may be observed, which morphologically resemble both. If, however, species is capable of being distributed across areas of wide extent, the transitional forms may become obliterated and the actual relation between the parent species and the modified form may be obscured. From whatever cause the species may have become modified it is evident that seasonal dimorphism is one of the fundamental results in such modification.

Such is unquestionably the case in the European species of *Euphrasia* and *Alectrorolophus*, which have become modified so as to represent distinct species, simply produced by the changes of conditions at harvest-time in the European meadows.

The history of *Gentiana* is somewhat different. We are here dealing with species, some of which are so closely related to each other that "annual" or "biennial," flowers "large" or

2 Wettstein, R. v. Der Saison-Dimorphismus als Ausgangspunkt für die Bildung neuer Arten in Pflanzenreiche. (Ber. Deutsch. Bot. Ges. XIII: 303. Berlin 1895.)

3 Sterneck, I. Beiträge zur Kenntniss der Gattung *Alectorolophus* (Oesterr. bot. Zeitschr. 1894.)

"small," and leaves "obtuse" or "acute" constitute some of the most important characters of distinction, yet with a geographic distribution of so marked characteristic, that their validity as species appears indisputable.

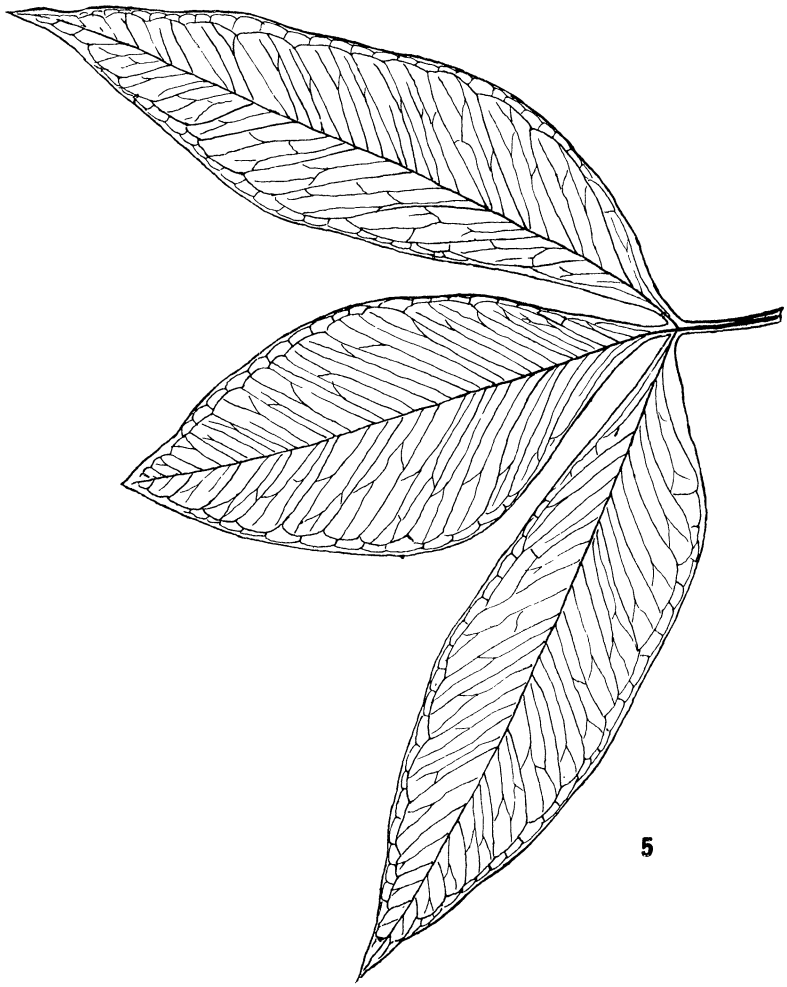


Figure 5. Leaf of a mature specimen of the variety *pusilla;* natural size.

Regarding *Arisaema triphyllum* we have a clear case in which "seasonal dimorphism" has produced a type, which I believe is about to develop as a distinct species. And there

cannot be any question of the parental species being the one, which we call typical *A. triphyllum*. For considering its morphological equipment, expressed by the characteristic structure of its organ of vegetative reproduction, the tuberous rhizome, such rhizome belongs to plants inhabiting higher situations, where it typically grows, and not to such as occur in low woods, inundated during the winter, or in bogs, sphagnum-bogs for instance. In the singular environment where the variety *pussilla* occurs, we have a natural explanation of the reason, why it blooms so much later than the typical plant. And accompanying this distinction as to time of flowering and fruiting we have seen the marked color of the spathe and spadix, the frequent variation in the leaf-outline, and the slender stem. If these characters remain constant, *"pussilla"* may eventually deserve specific rank, and we shall have a well founded proof of how some species may arise and "from more than one single area." For it is hardly possible to believe that the variety *pussilla,* as it grows in Maryland, originally came from the north, where it also occurs, or vice versa. It might have become distributed by means of the berries, but it seems much more reasonable to suppose, that the change of environment has produced this particular type, "wherever it occurs." A conclusion to that effect would only corroborate the view advanced by Wallace: "that every species has come into existence coincident both in space and time with a pre-existing closely allied species"—with the typical form of *Arisaema triphyllum* in this particular case. We would at the same time see no obstacle against believing that each species does not need to have been produced within one area, from where it migrated as far as it could; the origin of the Euphrasiae, the Gentianae, the species *Alectorolophus,* and our variety of *Arisaema* seem to depend on factors, some of which are among those which Schouw evidently had in mind, when he wrote his thesis: "De sedibus plantarum "originariis"[4] and reached the conclusion: "Eadem momenta cosmica easdem plantas diversis in locis produxise."

This hypothesis of Schouw was not new however, for it had actually been proposed by Gmelin in his "Sermo de

4 Kjoebenhavn 1816.

novorum vegetabilium post creationem divinam extortu.[5] It was accepted by some few of the leading botanists, for instance, by Elias Fries[6]; but while Alphonse De Candolle once adopted and strenuously maintained Schouw's hypothesis,[7] he has in effect discarded it in his "Géographie botanique" (1855).

Since then very little has been written about this subject, at least from the viewpoint of Schouw; there is, however, an interesting paper by K. Mueller: "Uber das relative Alter der Alpenflor,"[8] in which the probability of several centers of creation is amply discussed in favor of Schouw's hypothesis. Indirectly, on the other hand, the question was brought up again by Kerner,[9] who demonstrates the possibility of hybrids giving rise to new species, when conditions are favorable. And we learn from another publication by this same author,[10] that Asyngamy i. e. Asynchronogamy may result in the formation of new species by means of favoring hybridization, and by rendering formation of new races possible.

Then with respect to seasonal dimorphism, we have in the works of Wettstein, Sterneck and Murbeck, cited above, an excellent illustration of the origin of certain species through factors, that may undoubtedly have exercised the same influence during epochs previous to the recent, and not being confined to a single area, but effective wherever the conditions are favorable.

CLINTON, MD., NOVEMBER, 1921.

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5 Tübingen 1749.

6 Den Linnéanska Botanikens forhallande till den nuvarande (Botaniska Utflygter Vol. 3. p. 114 Stockholm 1864).

7 Fragment d'un discours sur la géographie botanique. Bibl. univ. 1834.

8 Botan. Zeitg. Vol. 16. No. 43. p. 321. 1858.

9 Konnen aus Bastarten Arten werden? (Oesterr. Botan. Zeitschr. Vol. 21. No. 8.

9 Konnen aus Bastartem Arten werden? (Oesterr. Botan. Zeitschr. Vol. 21. No. 8. 1871.)

10 Uber die Bedeutung der Asyngamie für die Entstehung neuer Arten. (Bericht. naturwiss. Vereins Innsbruck 1874.)